Physical Review B - Condensed Matter and Materials Physics 2006 vol.74 N18

Cross-relaxation and phonon bottleneck effects on magnetization dynamics in LiY F4: Ho3+

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Abstract

Frequency and dc magnetic field dependences of dynamic susceptibility in diluted paramagnets LiY F4: Ho3+ have been measured at liquid helium temperatures in ac and dc magnetic fields parallel to the symmetry axis of a tetragonal crystal lattice. Experimental data are analyzed in the framework of the microscopic theory of relaxation rates in the manifold of 24 electron-nuclear sublevels of the lowest non-Kramers doublet and the first excited singlet in the Ho3+ ground multiplet I85 split by the crystal field of S4 symmetry. The one-phonon transition probabilities were computed using electron-phonon coupling constants calculated in the framework of the exchange charge model and were checked by optical piezospectroscopic measurements. The specific features observed in field dependences of the in- and out-of-phase susceptibilities (humps and dips, respectively) at the crossings (anticrossings) of the electron-nuclear sublevels are well reproduced by simulations when the phonon bottleneck effect and the cross-spin relaxation are taken into account.

http://dx.doi.org/10.1103/PhysRevB.74.184421